Appendix 11.3

GEOPHYSICAL SURVEY EAST

Geophysical Survey Report

Land at J10, M40, Baynards Green (Eastern Parcel)

Prepared with:

magnitude surveys

JAC27300
Land at J10, M40, Baynards Green, Oxfordshire
Version 1
June 2021

rpsgroup.com

Quality Management					
Version	**Status**	**Authored by**	**Reviewed by**	**Approved by**	**Date**
Version 1	For Client Comment	Megan Clements & Filippo Carrozzo	Kayt Armstrong	James Archer	15/06/2021

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15 June 2021

Abstract

Magnitude Surveys Ltd was commissioned to assess the subsurface archaeological potential of a c.23.8ha area of land near Baynard's Green, Oxfordshire. A fluxgate gradiometer survey was successfully completed across the survey area. The geophysical survey has identified anomalies of agricultural origin that consist of several regimes of modern ploughing reflecting potential changes in the land management of the survey area. Near surface geological and pedological changes have created a complex geophysical background across the survey area; in places, complicating the interpretation leading to a more tentative classification of anomalies. Modern interference is limited to the edges of the survey area and is a result of extant field boundaries. No anomalies suggestive of extensive archaeological remains have been identified, but the presence of linear anomalies of undetermined origin means that archaeological remains cannot be ruled out.

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1. Introduction

1.1. Magnitude Surveys Ltd (MS) was commissioned by RPS London to undertake a geophysical survey over a c. 23.8ha area of land at near Baynard's Green, Cherwell, Oxfordshire (SP 5492 2897).

1.2. The geophysical survey comprised hand-carried GNSS-positioned fluxgate gradiometer survey. Magnetic survey is the standard primary geophysical method for archaeological applications in the UK due to its ability to detect a range of different features. The technique is particularly suited for detecting fired or magnetically enhanced features, such as ditches, pits, kilns, sunken featured buildings (SFBs) and industrial activity (David *et al*., 2008).

1.3. The survey was conducted in line with the current best practice guidelines produced by Historic England (David *et al*., 2008), the Chartered Institute for Archaeologists (CIfA, 2020) and the European Archaeological Council (Schmidt *et al.,* 2015).

1.4. It was conducted in line with a WSI produced by MS (Salmon, 2021).

1.5. The survey commenced on 25/05/21 and took 3 days to complete.

2. Quality Assurance

2.1. Magnitude Surveys is a Registered Organisation of the Chartered Institute for Archaeologists (CIfA), the chartered UK body for archaeologists, and a corporate member of ISAP (International Society for Archaeological Prospection).

2.2. The directors of MS are involved in cutting edge research and the development of guidance/policy. Specifically, Dr Chrys Harris has a PhD in archaeological geophysics from the University of Bradford, is a Member of CIfA and is the Vice-Chair of the International Society for Archaeological Prospection (ISAP); Finnegan Pope-Carter has an MSc in archaeological geophysics and is a Fellow of the London Geological Society, as well as a member of GeoSIG (CIfA Geophysics Special Interest Group); Dr Kayt Armstrong has a PhD in archaeological geophysics from Bournemouth University, is a Member of CIfA, the Editor of ISAP News, and is the UK Management Committee representative for the COST Action SAGA; Dr Paul Johnson has a PhD in archaeology from the University of Southampton, is a Fellow of the Society of Antiquaries of London, has been a member of the ISAP Management Committee since 2015, and is currently the nominated representative for the EAA Archaeological Prospection Community to the board of the European Archaeological Association.

2.3. All MS managers, field and office staff have degree qualifications relevant to archaeology or geophysics and/or field experience.

3. Objectives

3.1. The objective of this geophysical survey was to assess the subsurface archaeological potential of the survey area.

4. Geographic Background

4.1. The survey area was located c.200m south east of the village of Baynard's Green, Oxfordshire (Figure 1). Gradiometer survey was undertaken across three fields under arable cultivation. The survey area was bounded by the B4100 to the northeast, the A43 to the west and northwest with further fields to the east and south (Figure 2).

4.2. Survey considerations:

Survey Area	Ground Conditions	Further Notes
1	The survey area consisted of a field with crop that slopes down towards the south	The survey area was bound to the north, east and west by hedgerow with a metal fence to the south. Small metal placement flags were also located within the survey area.
2	The survey area consisted of a field with crop that slopes down towards the south.	The survey area was bound to the north and east by hedgerow with a metal fence to the south and west. Small placement flags were also located within the survey area.
3	The survey area consisted of a field with crop that slopes down slightly towards the east.	The survey area was bound to the east and west by a metal fence with hedgerow to the south. Small placement flags were also located within the survey area.

4.3. The underlying geology comprises of White limestone Formation, no superficial deposits are recorded within the survey area; however adjacent to the southern boundary, formations of alluvium are noted (British Geological Survey, 2021).

4.4. The soils consist of freely draining lime-rich loamy soil (Soilscapes, 2021).

5. Archaeological Background

5.1. The following summarises the results of an HER search conducted by Oxfordshire HER and provided by RPS London.

5.2. Evidence of Neolithic and Later Prehistoric activity recorded within and around the survey area is limited to two monuments within and just northwest of Stoke Lyne. The first, a single ditch forming an incomplete sub-rectangular 'enclosure' (MOX12362) aligned approximately northwest – southeast is considered a possible Neolithic long mortuary enclosure or cursus. The second c.620m north east of the survey area is a possible Banjo Enclosure (MOX23339) visible in aerial photography.

5.3. Bronze Age and Iron Age activity within the wider study area consists of a number of different ditch or enclosure features. Approximately 530m to the north of the survey area is a possible Bronze Age ring ditch (MOX27036). Two Late Iron Age Banjo enclosures are noted southwest of the survey area (MOX4873 & MOX4865) c.680m & 1200m respectively, both identified from aerial photography of the surrounding area.

5.4. A single find spot of Roman pottery and coins (MOX4812) c.1000m southwest of the survey area is the only evidence of Roman activity within the wider search area.

5.5. Medieval and Post Medieval activity surrounding the survey area is predominantly related to the buildings and farmhouses in the nearby villages, with mention of Manor Farmhouse dating to the 17th Century (MOX13973). Records of a Deserted Medieval Village exist, the site of which is now lost (MOX4745). Just to the south east of the village of Fritwell is the site of a Medieval limestone quarry, considered to have been used for road repairs.

5.6. Numerous other undated monuments have been identified within the wider search area. These monuments have been detected by a variety of sources, including the preliminary survey of the M40 (MOX4833) which identified linear features and a ring ditch belonging to two partial enclosure complexes (MOX23340 & MOX23341) c.1.7km north of the survey area.

6. Methodology

6.1. Data Collection

6.1.1. Magnetometer surveys are generally the most cost effective and suitable geophysical technique for the detection of archaeology in England. Therefore, a magnetometer survey should be the preferred geophysical technique unless its use is precluded by any specific survey objectives or the site environment. For this site, no factors precluded the recommendation of a standard magnetometer survey. Geophysical survey therefore comprised the magnetic method as described in the following section.

6.1.2. Geophysical prospection comprised the magnetic method as described in the following table.

6.1.3. Table of survey strategies:

Method	Instrument	Traverse Interval	Sample Interval
Magnetic	Bartington Instruments Grad-13 Digital Three-Axis Gradiometer	1m	200Hz reprojected to 0.125m

6.1.4. The magnetic data were collected using MS' bespoke hand-carried GNSS-positioned system.

6.1.4.1. MS' hand-carried system was comprised of Bartington Instruments Grad 13 Digital Three-Axis Gradiometers. Positional referencing was through a multi-channel, multi-constellation GNSS Smart Antenna RTK GPS outputting in NMEA mode to ensure high positional accuracy of collected measurements. The RTK GPS is accurate to 0.008m + 1ppm in the horizontal and 0.015m + 1ppm in the vertical.

6.1.4.2. Magnetic and GPS data were stored on an SD card within MS' bespoke datalogger. The datalogger was continuously synced, via an in-field Wi-Fi unit, to servers within MS' offices. This allowed for data collection, processing and visualisation to be monitored in real-time as fieldwork was ongoing.

6.1.4.3. A navigation system was integrated with the RTK GPS, which was used to guide the surveyor. Data were collected by traversing the survey area along the longest possible lines, ensuring efficient collection and processing.

6.2. Data Processing

6.2.1. Magnetic data were processed in bespoke in-house software produced by MS. Processing steps conform to the EAC and Historic England guidelines for 'minimally enhanced data' (see Section 3.8 in Schmidt *et al.*, 2015: 33 and Section IV.2 in David *et al.,* 2008: 11).

Sensor Calibration – The sensors were calibrated using a bespoke in-house algorithm, which conforms to Olsen *et al*. (2003).

Zero Median Traverse – The median of each sensor traverse is calculated within a specified range and subtracted from the collected data. This removes striping effects caused by small variations in sensor electronics.

Projection to a Regular Grid – Data collected using RTK GPS positioning requires a uniform grid projection to visualise data. Data are rotated to best fit an orthogonal grid projection and are resampled onto the grid using an inverse distance-weighting algorithm.

Interpolation to Square Pixels – Data are interpolated using a bicubic algorithm to increase the pixel density between sensor traverses. This produces images with square pixels for ease of visualisation.

6.3. Data Visualisation and Interpretation

6.3.1. This report presents the gradient of the sensors' total field data as greyscale images, as well as the total field data from the upper and/or lower sensors. The gradient of the sensors minimises external interferences and reduces the blown-out responses from ferrous and other high contrast material. However, the contrast of weak or ephemeral anomalies can be reduced through the process of calculating the gradient. Consequently, some features can be clearer in the respective gradient or total field datasets. Multiple greyscale images of the gradient and total field at different plotting ranges have been used for data interpretation. Greyscale images should be viewed alongside the XY trace plot (Figures 7 & 10). XY trace plots visualise the magnitude and form of the geophysical response, aiding anomaly interpretation.

6.3.2. Geophysical results have been interpreted using greyscale images and XY traces in a layered environment, overlaid against open street maps, satellite imagery, historical maps, LiDAR data, and soil and geology maps. Google Earth (2021) was also consulted, to compare the results with recent land use.

6.3.3. Geodetic position of results – All vector and raster data have been projected into OSGB36 (ESPG27700) and can be provided upon request in ESRI Shapefile (.SHP) and

Geotiff (.TIF) respectively. Figures are provided with raster and vector data projected against OS Open Data.

7. Results

7.1. Qualification

7.1.1. Geophysical results are not a map of the ground and are instead a direct measurement of subsurface properties. Detecting and mapping features requires that said features have properties that can be measured by the chosen technique(s) and that these properties have sufficient contrast with the background to be identifiable. The interpretation of any identified anomalies is inherently subjective. While the scrutiny of the results is undertaken by qualified, experienced individuals and rigorously checked for quality and consistency, it is often not possible to classify all anomaly sources. Where possible, an anomaly source will be identified along with the certainty of the interpretation. The only way to improve the interpretation of results is through a process of comparing excavated results with the geophysical reports. MS actively seek feedback on their reports, as well as reports from further work, in order to constantly improve our knowledge and service.

7.2. Discussion

7.2.1. The geophysical results are presented in combination with historical maps and satellite imagery (Figure 4).

7.2.2. The geophysical survey was successfully completed across the survey area. The fluxgate gradiometer survey has responded well to the environment of the survey area, with anomalies of natural, agricultural and undetermined origin being detected. Modern interference from extant field boundaries has been identified, but has had a limited impact on the results.

7.2.3. Natural variations in the near surface geology are evident across the survey area, characteristic of variations and natural processes in the limestone bedrock (see section 4.3). Larger, more amorphous zones of material likely correspond with changes in the soils contrasting with the bedrock below. More discrete bands and trends are indicative of imperfections in the bedrock.

7.2.4. Anomalies relating to agricultural activity have been detected across the survey area. These comprise of linear anomalies that have been interpreted to be modern ploughing trends with some areas of enhanced ploughing being detected around the edges of the survey area. The opposing orientations of the trends suggest that multiple systems of ploughing regimes have been used in regard to the cultivation of the survey areas.

7.2.5. Anomalies of undetermined classification have also been identified. These anomalies have been interpreted as areas of possible high temperature activity. Additional linear anomalies have also been detected for which an archaeological origin cannot be ruled out. This is especially true given that prehistoric enclosures have been recorded within the wider landscape (see section 5.2 & 5.3). While it is not possible to confidently classify these linear anomalies as archaeological based on this evidence, the possibility remains that these anomalies could be of a similar origin.

7.3. Interpretation

7.3.1. General Statements

7.3.1.1. Geophysical anomalies will be discussed broadly as classification types across the survey area. Only anomalies that are distinctive or unusual will be discussed individually.

7.3.1.2. **Ferrous (Spike)** – Discrete dipolar anomalies are likely to be the result of isolated pieces of modern ferrous debris on or near the ground surface.

7.3.1.3. **Magnetic Disturbance** – The strong anomalies produced by extant metallic structures, typically including fencing, pylons, vehicles and service pipes, have been classified as 'Magnetic Disturbance'. These magnetic 'haloes' will obscure weaker anomalies relating to nearby features, should they be present, often over a greater footprint than the structure causing them.

7.3.1.4. **Undetermined** – Anomalies are classified as Undetermined when the origin of the geophysical anomaly is ambiguous and there is no supporting contextual evidence to justify a more certain classification. These anomalies are likely to be the result of geological, pedological or agricultural processes, although an archaeological origin cannot be entirely ruled out. Undetermined anomalies are generally distinct from those caused by ferrous sources.

7.3.2. Magnetic Results - Specific Anomalies

7.3.2.1. **Agricultural (Weak & Trend)** – In the southeast of Area 1, a diffuse linear anomaly has been interpreted to be enhanced soils as a result of headland accumulation from ploughing (Figure 8). In addition, across the survey area linear trends have been identified that correspond with the current ploughing regime identified through modern satellite imagery (Figures 6 & 9). Some of the visible linear trends appear to correspond with a different phase of agricultural activity within the survey area, suggestive of a change in field layout. Some trends may be drainage features however it is difficult to make a confident distinction due to the weak magnetic enhancement of the anomalies and the complexity of the natural variations present across the survey area.

7.3.2.2. **Natural (Weak & Strong)** – Anomalies indicative of subsurface variations in the underlying geology and soil properties have been identified across the survey area. These variations are most explicit in the Total Field data (Figure 3). The most prominent and clearly defined have been categorised individually as both strong discrete anomalies and slightly weaker bands, indicative of imperfections in the limestone bedrock. A 'Natural Zone' classification has been used to highlight areas of weaker background texture, suggestive of changes in the soil composition or depth (see sections 4.3 & 4.4).

7.3.2.3. **Undetermined (Strong)** – Across the survey area discrete anomalies have been identified (Figures 6 & 9). These anomalies are atypical when compared to standard ferrous type anomalies in that they display a negative centre surrounded by a positive halo (Figures 5 & 8). This, and their strong XY Trace Plot signal (Figure 7 & 10), suggest high temperature activity, though whether linked to archaeological, agricultural or modern processes is unclear.

7.3.2.4. **Undetermined (Weak)** – In the south of Areas 1 and 3 and the south and west of Area 2, are linear anomalies with a weak magnetic enhancement (Figures 6 & 9). While these anomalies could have been produced due to natural variations in the background geology, they are slightly more coherent and rectilinear than the anomalies resulting from the geology. Thus, an archaeological origin cannot be entirely ruled out, particularly given the presence of recorded prehistoric enclosures within the wider landscape of the survey area. However, the most coherent group of anomnalies also border the route of the A43 as it passes the survey area, and so may equally have a recent or agricultural origin related to the road.

8. Conclusions

8.1. A fluxgate gradiometer survey has successfully been undertaken across the survey area. The geophysical survey has detected anomalies of agricultural and modern origin. Anomalies relating to modern activity has been produced by extant field boundaries.

8.2. Agricultural activity has been identified in the form of multiple systems of modern ploughing cultivation. Some areas of enhanced ploughing have also been detected around the edges of the survey area.

8.3. Natural variations in the background geology of the survey area have been detected. These anomalies are likely related to imperfections in the limestone bedrock and changes in the superficial/sedimentary deposits.

8.4. No anomalies strongly suggestive of archaeological activity have been identified, however anomalies of undetermined origins have been detected. It has not been possible to definitively determine whether these anomalies are the result of archaeological, agricultural or modern practises.

9. Archiving

9.1. MS maintains an in-house digital archive, which is based on Schmidt and Ernenwein (2013). This stores the collected measurements, minimally processed data, georeferenced and un-georeferenced images, XY traces and a copy of the final report.

9.2. MS contributes reports to the ADS Grey Literature Library upon permission from the client, subject to any dictated time embargoes.

10. Copyright

11. References

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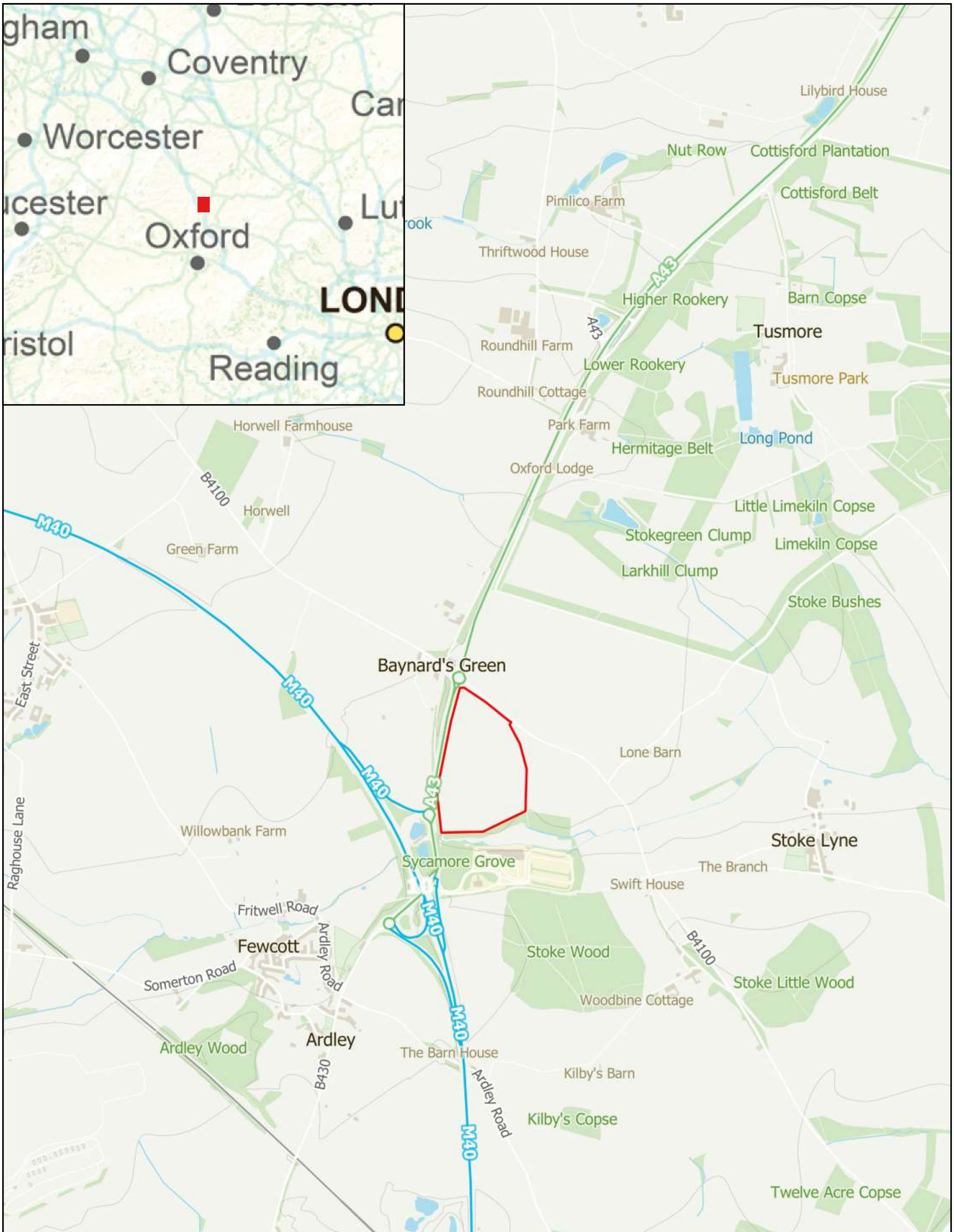
12. Project Metadata

MS Job Code	MSSP963
Project Name	J10, M40, Baynard's Green – Area to east of A43
Client	RPS London
Grid Reference	SP 5492 2897
Survey Techniques	Magnetometry
Survey Size (ha)	23.8ha (Magnetometry)
Survey Dates	25/05/2021 – 27/05/2021
Project Lead	Frederick Salmon BSc FGS ACIfA
Project Officer	Frederick Salmon BSc FGS ACIfA
HER Event No	N/A
OASIS No	N/A
S42 Licence No	N/A
Report Version	Final

13. Document History

Version	Comments	Author	Checked By	Date
0.1	Initial draft for Project Lead to Review	MC FC	FS	03 June 2021
0.2	Review for Project Manager	MC	KA	04 June 2021
Final	Issued as final	FS	N/A	15 June 2021



MSSP963 - J10, M40, Baynards Green, Oxfordshire
Figure 1 - Site Location
1:25,000 @ A4

Site Boundary

N

0 0.5 1 km

magnitude surveys

MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 2 - Location of Survey Areas
1:10,000 @ A3

Survey Extent

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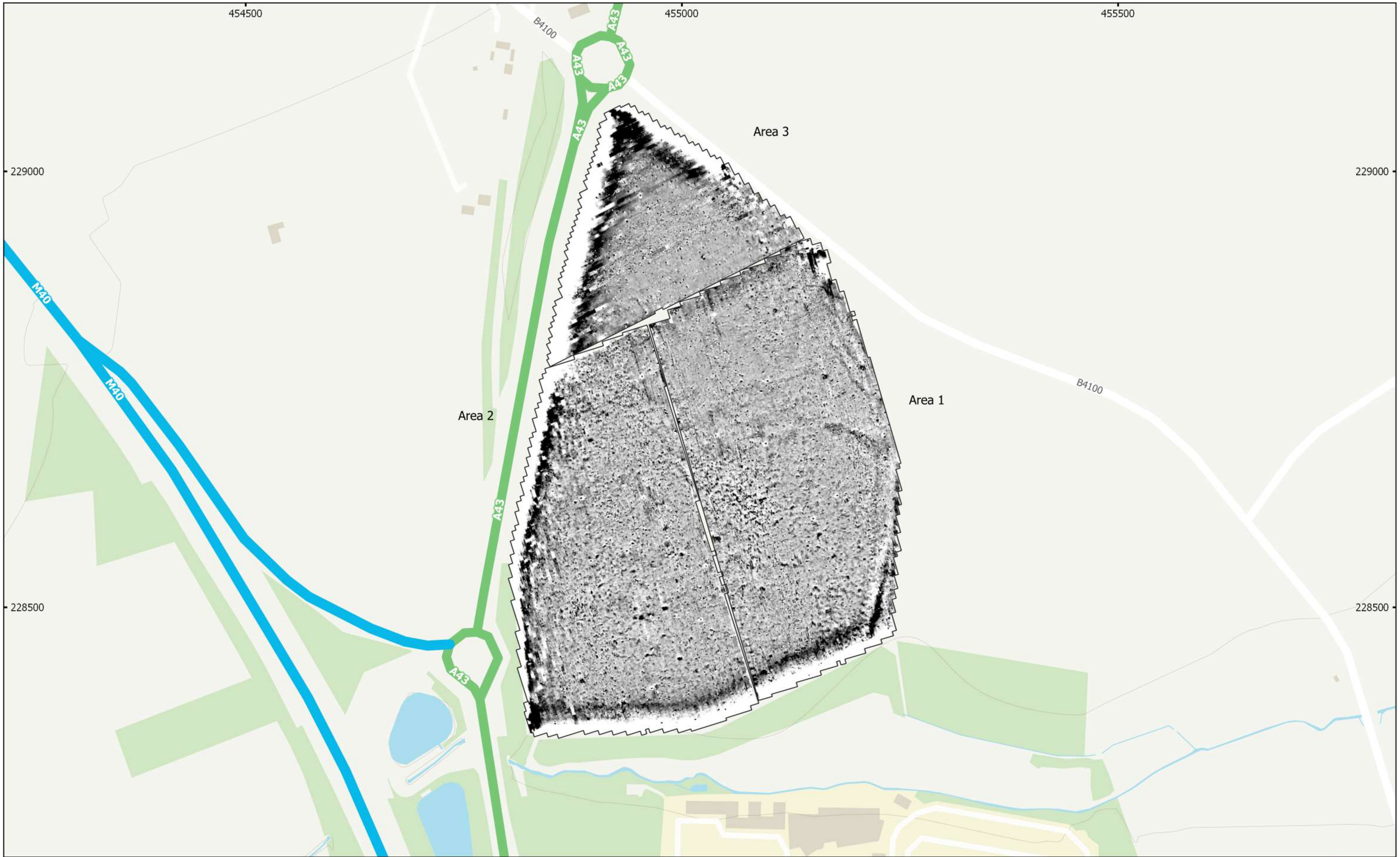

MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 3 - Magnetic Total Field (Lower Sensor)(Overview)
1:4,000 @ A3

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MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 4 - Magnetic Interpretation Over Historical Maps and Satellite Imagery (Overview)
1:4,000 @ A3
Copyright Magnitude Surveys Ltd 2021
Contains historical maps: Ordnance Survey, 6" 2nd edition c. 1882-1913.
Contains satellite imagery © 2021 Bing Satellite

Agricultural (Weak)
Natural (Strong)
Natural (Weak)
Natural (Zone)
Magnetic Disturbance
Undetermined (Strong)
Undetermined (Weak)
Agricultural (Trend)

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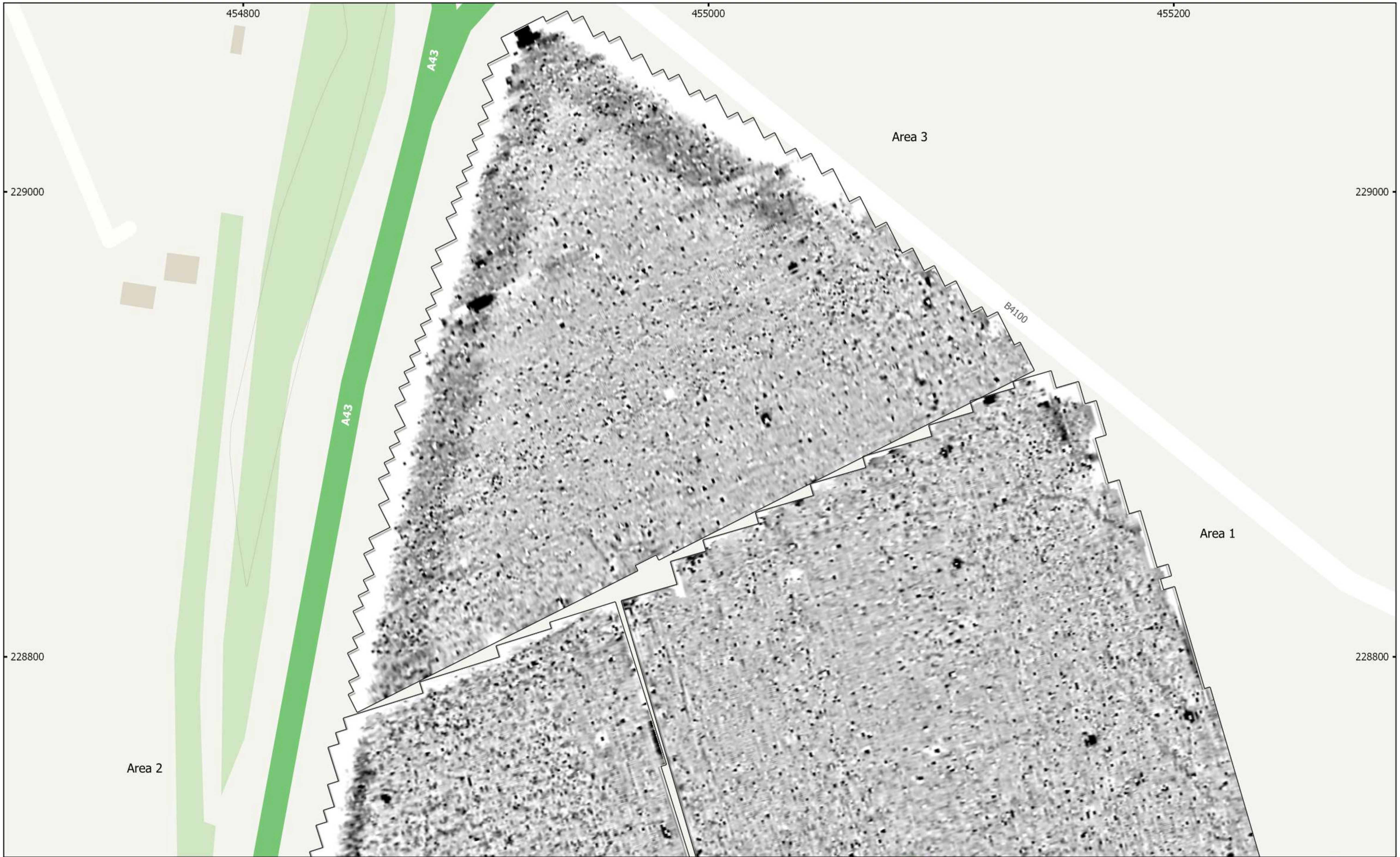

MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 5 - Magnetic Gradient (North)
1:1,500 @ A3

-1 nT 2

N

0 40 80 120 m

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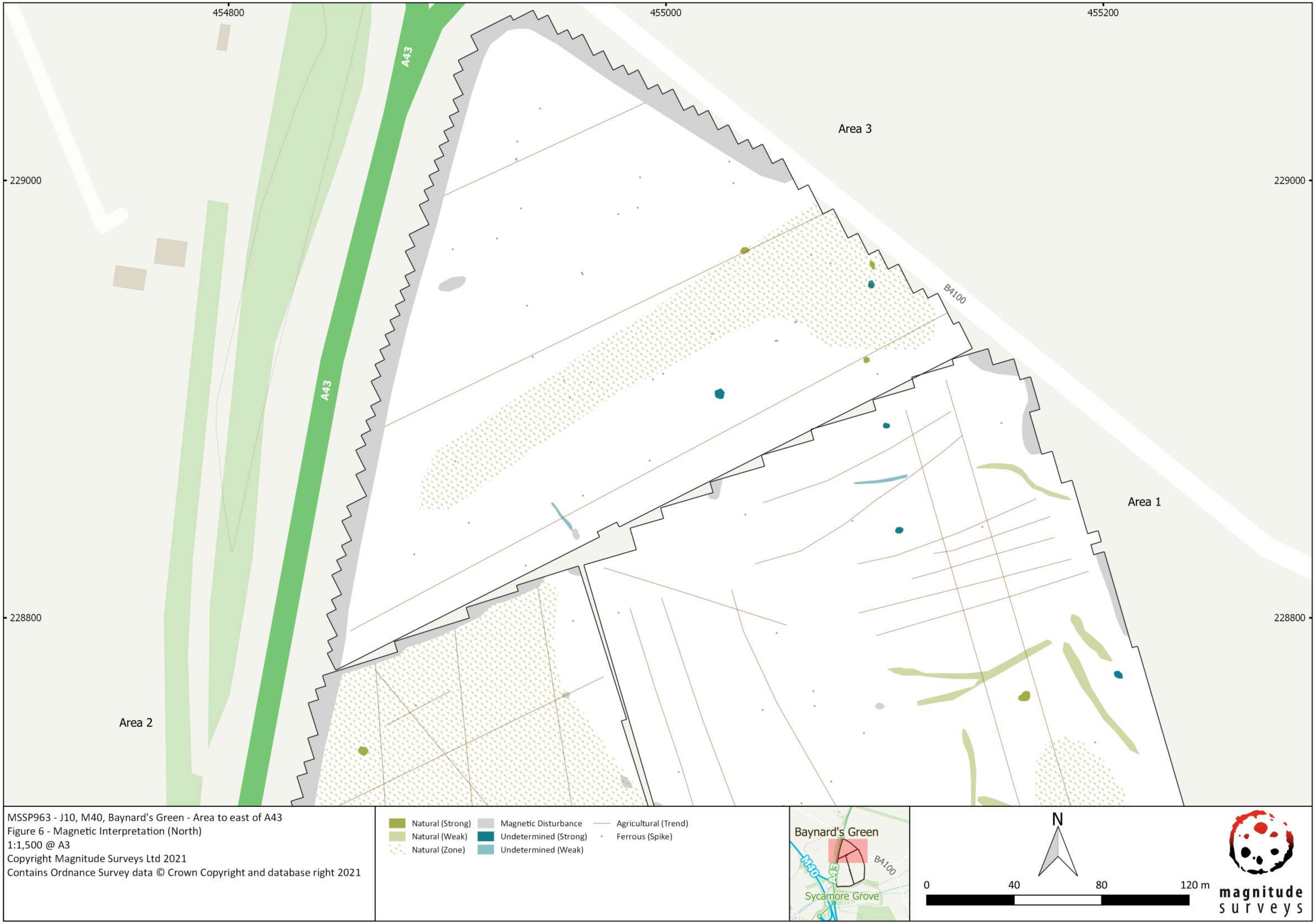
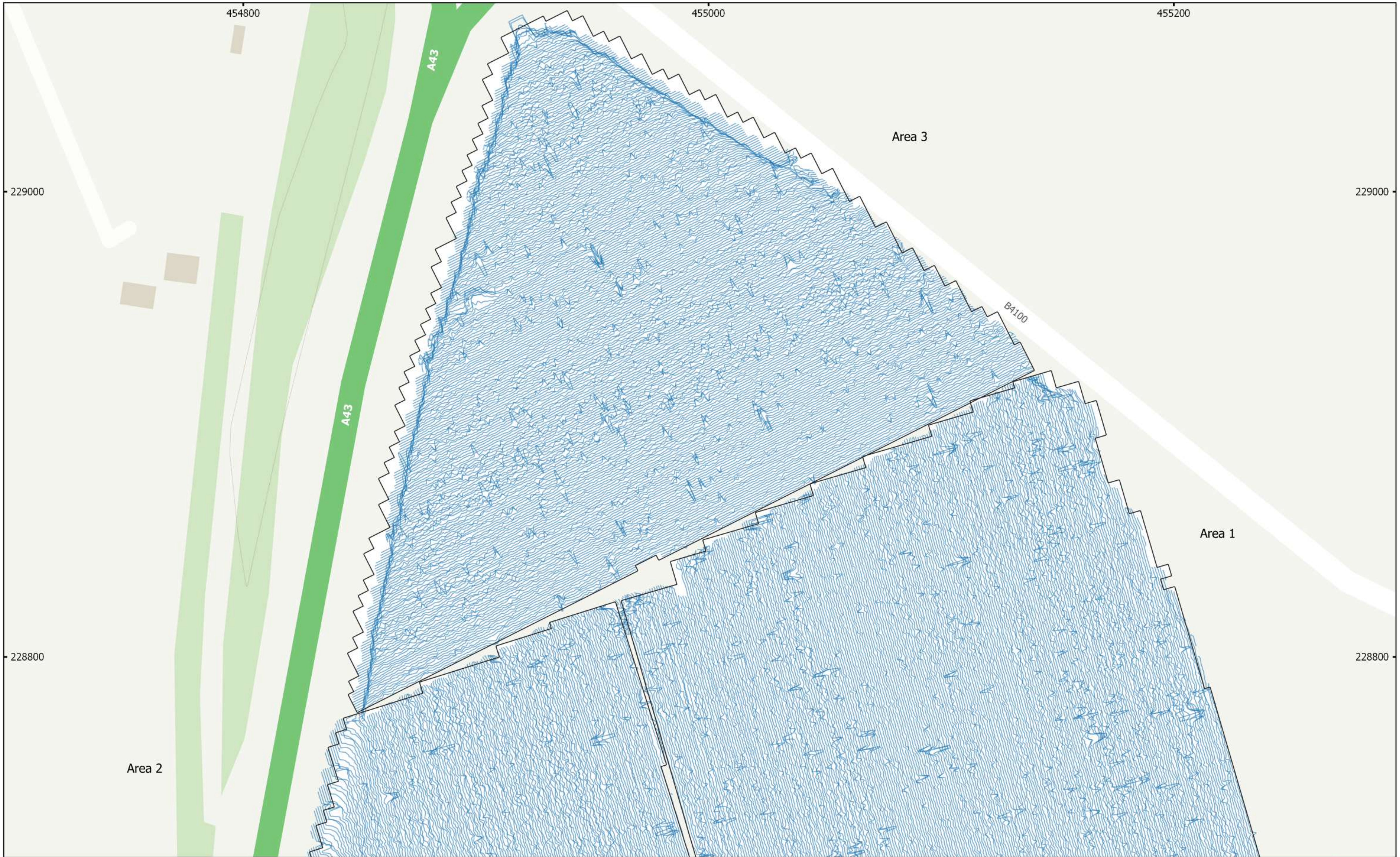
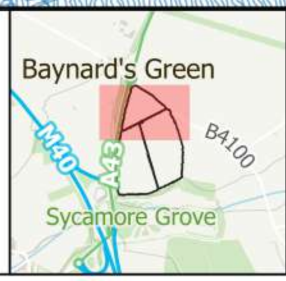


MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 6 - Magnetic Interpretation (North)
1:1,500 @ A3



MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 7 - XY Trace Plot (North)
30nT/cm at 1:1,500 @ A3



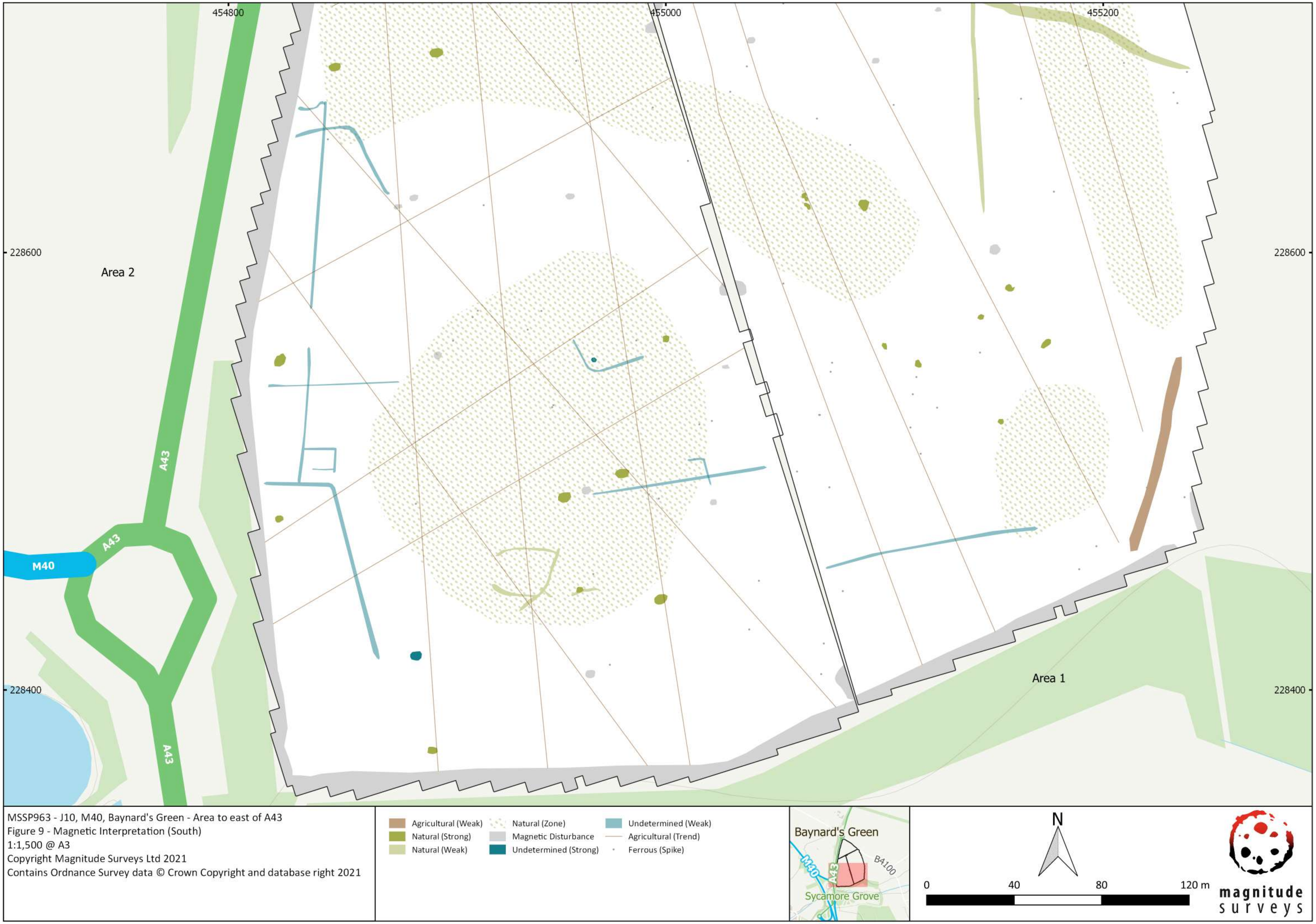
N

0 40 80 120 m

magnitude surveys

MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 8 - Magnetic Gradient (South)
1:1,500 @ A3

magnitude surveys

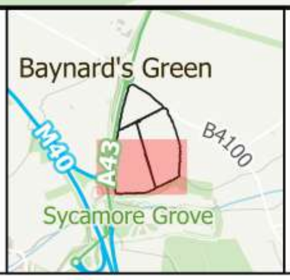


MSSP963 - J10, M40, Baynard's Green - Area to east of A43

Figure 9 - Magnetic Interpretation (South)

1:1,500 @ A3

MSSP963 - J10, M40, Baynard's Green - Area to east of A43
Figure 10 - XY Trace Plot (South)
30nT/cm at 1:1,500 @ A3



N

0 40 80 120 m

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